CHROMOSOME NUMBERS IN THE GENUS TILIA

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With text figures

THE FAMILY Tiliaceae contains about 35 genera and some 400 species (Rehder, 1927). The genus *Tilia* is the only member of the family which is found widely distributed in the north temperate zone, while of the genus *Grewia* only *G. biloba* G. Don extends north as far as northern China.

The fossils that have been recorded are limited to ancestral forms of *Tilia* according to Berry (1923) which have been discovered in the northern hemisphere in early and late tertiary formations. These fossils have been found in Spitzbergen, Alaska, Saghalin Island and in Montana, which would indicate that Tilia stock originated somewhere in the far north.

From the Arnold Arboretum plants of ten species and five varieties of *Tilia* and one species of *Grewia* were studied and their chromosome numbers determined. Meiotic figures were drawn from aceto-carmin smear preparations from buds, and somatic chromosomes from root-tip sections. The chromosome numbers of *Tilia* plants were determined from buds and in one case also from root-tips. The number of chromosomes in *Tilia* was n = 41 (Fig. 1), making this the highest odd basic number for a genus in plants so far recorded in the published chromosome lists of Tischler (1931) and Gaiser (1930). Eleven plants were diploid forms and four tetraploid forms with n = 82 chromosomes. The diploid forms are: *Tilia cordata*, *T. cord. cordifolia*, *T. glabra*, *T. neglecta*, *T. Oliveri*, *T. petiolaris*, *T. platyphyllos laciniata*, *T. plat. vitifolia*, *T. plat.* var. (Fig. 2), *T. vulgaris* (Fig. 1), *T. vulgaris pallida*. The tetraploid forms are: *Tilia amurensis*, *T. insularis*, *T. Maximowicziana* and *T. tuan*.

A single species of the related genus *Grewia* was studied from bud and root-tip preparations to see if it was cytologially related to *Tilia*. The only relationship found was one of size, both *Tilia* and *Grewia* having very small chromosomes, measuring about 1 micron in length and ½ micron in thickness (Figs. 2 and 4). In this species, *G. biloba* G. Don (*G. parviflora* Bge.) the number was n = 9 (Fig. 3).

If the Tiliaceae originated from forms with such a low basic number of chromosomes, the number found in *Tilia* must have been derived by both duplication and fragmentation of chromosomes of the basic complex. The possibility of fragmentation is shown in

Grewia where frequently segments are so loosely joined as to be mistaken for whole chromosomes (Fig. 4). Therefore it is suggested that in the case of *Tilia* some of these segments may have been actually broken off and perpetuated as individual chromosomes. The same difficulty was encountered in counting and drawing chromosomes of *Tilia* from root-tip sections where sometimes the number appeared to be 84 instead of 82, though the number of both genera was definitely determined as n = 41 for *Tilia* and n = 9 for *Grewia*.

Fig. 1 Fig. 2 Fig. 3 Fig. 4

(Explanation in the text)

Some pollen grain measurements were made and practically no difference in size was found between diploid and tetraploid species. *Grewia* with only n = 9 chromosomes had pollen grains which were equal to or larger than those of *Tilia*.

Gaiser (1930) lists a number of species from related families of Tiliaceae. The original references were studied to find out whether these species showed any cytological relationship to *Tilia* or *Grewia*.

In the Malvaceae family *Malva moschata* (n = ?), *Lavatera thuringiaca* (n = 20?), *Althaea sulphurea* (n = ?), *Malvastrum capense* (n = 21), *Sidalcea neo-mexicana* (n = 13), and of the Tiliaceae family, *Entelea palmata* (n = 8) and *Sparmannia africana* (n = 82) had practically the same size of chromosomes as *Tilia*. In the tribe Hibisceae of the Malvaceae family, *Hibiscus tricuspis* (n = 40?), *H. tiliaceus* (n = 48?) and *Gossypium barbadense* (n = 8, 13, 26) chromosomes are somewhat larger, while in *Hibiscus rosa-sinensis* (n = 72?) they are slightly smaller as compared with Tilia chromosomes. The only species, *Theobroma cacao* (n = 8), from the family Sterculiaceae has chromosomes of the same size as in *Tilia*. The only striking diversity was found in the size of *Thespesia populnea* (n = 8, 10, 13) chromosomes, which are shown to be several times larger than any of the above named species.

If size of chromosomes can be considered of any importance in the relationship of plants certainly these genera from allied families of the Malvales order seem to indicate that they are cytologically related to one another, the only striking exception being *Thespesia populnea* with very large chromosomes. A case similar to this was

found in my studies of the genus *Verbena* of the Verbenaceae family (unpublished data). Here the genus was divided into two distinct groups, one with a basic number n = 5 chromosomes and one with n = 7, the latter group having chromosomes about 1/10 the size of the former.

LITERATURE CITED

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